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ABSTRACT

This report examines the institutional level deacidification program that was formalized and instituted at Harvard University (Cambridge, Massachusetts)) for its research libraries. The report is organized into six sections. The first section, which describes the project's background, discusses the acidic paper problem, available mass deacidification technology, the Harvard pilot program for its libraries, and mass deacidification at the national and international levels. The selection process for mass deacidification is described in the second section on two levels: (1) the exploration of an overall intellectual approach and the development of a model based on the pilot operational program to select, send, and receive materials that have been deacidified; and (2) the physical selection process itself, which covers leather bindings, coated paper, adhesives, labels, plastics, and photographs. The third section considers program processing: packing, shipping, recordkeeping, marking bibliographic records, and turn-around-time; and the fourth section covers treatment concerns. The final two sections present project numbers and costs, and the 1992/93 plan of work. (GLR)

Mass Deacidification in the Harvard University Library
A Report on the 1991/92 Pilot Operational Program

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1.0 BACKGROUND

Harvard's interest in mass deacidification on the institutional level was formalized in 1990 with the appointment of a University Library task group. The task group was charged to consider the benefits and costs of mass deacidification, review available treatment processes, and recommend a course of action. The work has been divided into three major phases: assessing available technology for mass deacidification, developing guidelines for the selection of materials suitable for treatment while conducting a pilot operational program, and exploring financial strategies.

A sub-group on deacidification technology was charged to review mass deacidification processes on behalf of the library, investigate the status of paper strengthening technology, conduct site visits to commercial facilities, and recommend the use of a particular vendor. This group completed its work in Fall 1991 and Harvard signed a contract with Akzo, Inc. to provide deacidification services.

The development of guidelines for selection began to take shape during the first year of the pilot operational program. In addition, libraries were able to acquire experience on a small scale; this experience will be used as the basis for future planning and implementation of the program on a larger-scale. In fact, a large-scale deacidification program will be the logical extension of the Library's Recon effort--in order to ensure that the materials we describe on-line actually continue to exist. The scope of Harvard's acidic paper problem should be calculated as the basis for developing strategic and financial plans for selected deacidification of the collections. The study should include the proportion of the retrospective collections as well as the newly acquired materials that are acidic. While fund-raising during the Harvard Campaign will be an important component of the mass deacidification program, the exploration of financial strategies also includes the possibility of working cooperatively with libraries in the region to acquire deacidification services.

The development of an overall approach to mass deacidification at Harvard is reflective of Harvard's decentralized system of research libraries. Decentralization has meant the distribution of responsibility to autonomous library units to build, describe, service, and preserve their collections. The development of Harvard-wide policies and guidelines for collection development, intellectual control and access, use of off-site storage, and preservation is accomplished through consensus and coordination among the individual libraries. Therefore, the approach to mass deacidification has been to develop consensus among collection managers and the heads of the various libraries about the appropriate use of this new technology as a preservation tool, and its relationship to other preservation options.

1.1 The Acidic Paper Problem

The Harvard book collections printed since 1940 are threatened with extinction. Approximately 3 million of Harvard's 12 million volumes exhibit severe paper embrittlement. The vast majority of the rest are printed on paper that is destined to become brittle and unusable because of its acidic content. Depending on the initial strength and fiber content of the paper comprising an individual book, this process can occur in as little as 50 years. Also threatened are Harvard's important and unique collections of manuscripts and archives.

The prognosis for new books entering the collections today is somewhat more optimistic. The source of the paper embrittlement problem was identified in the late 1950s and an alkaline paper size became commercially available to replace acidic alum rosin sizing. Further progress has been made recently with the development in 1984 of an American National Standard for Permanent Paper and its revision in 1991 to include coated paper. The U.S. standard was the basis for a 1992 international standard. The number of paper mills "going alkaline" is steadily increasing due to the environmental and maintenance advantages of running an alkaline mill. While alkaline paper production in North American in 1988 represented approximately 19% of the production of "free sheets" (paper free of groundwood), in 1990 alkaline paper was 64% of the total produced.

Mass deacidification is not the only option for acidic paper; storing lesser-used library materials in the lower temperature and humidity environment maintained at HD extends the useful life of paper 10-fold. There are similar advantages to archival storage for other formats, such as photographs and magnetic tape. Storing acidic books in the optimum preservation environment of the Harvard Depository will stabilize their condition and enable the Library to concentrate preservation resources on the more heavily-used portions of the collection. Materials stored at HD may not need to be deacidified, or may be a lower priority for treatment.

If we act now, Harvard may be able to isolate and contain its acidic paper problem within this century.

1.2 Mass Deacidification Technology

Beginning in the 1960s, libraries have sponsored research and development to find a solution to the problem of acidic paper and encourage activity in the private sector. While at one time there were as many as five different processes under commercial development, only one process, the diethyl zinc gaseous deacidification process, is currently viable. The DEZ process was invented at the Library of Congress and developed by LC and Akzo

Chemicals, Inc. at Akzo's pilot plant located at Texas Alkyls in Deer Park, Texas (outside of Houston).

The DEZ mass deacidification process chemically treats whole volumes or groups of paper documents in a vacuum chamber. In the vacuum treatment chamber, air and moisture are removed and molecules of highly volatile diethyl zinc gas permeate the chamber and penetrate between the pages of closed books. The process neutralizes the acid in the paper and leaves an alkaline reserve to buffer against future acid attack from the environment. A post-treatment process reduces odor and restores most of the natural level of moisture that paper needs for flexibility.

1.3 The pilot program in the Harvard libraries

Based on the successful treatment of sample materials and the judgement of the technology task group, which included Harvard professors James Butler (Division of Applied Sciences) and Andrew Barron (Department of Chemistry), the Preservation Office launched the pilot operational program. In May 1991, collection managers at Harvard participated in a meeting with Richard Miller, Deacidification Project Manager for Akzo Chemicals, Inc., to discuss the treatment process, logistics, and selection criteria. At the start of the new fiscal year, Richard De Gennaro, Librarian of Harvard College, authorized $50,000 in supplemental funds to help launch the program. In November 1991, a start-up meeting was held with staff from the participating libraries. Richard Miller of Akzo and Mildred Jeffery, Project Engineer, attended to assist in the discussion of operational issues. A tentative schedule of shipments was agreed to.

As the program began Lisa Biblo, the new HUL Preservation Information Librarian, Carolyn Morrow, Malloy-Rabinowitz Preservation Librarian, and Nancy Schrock, Conservation Consultant, met with participating libraries to help select and pack shipments. Each shipment was a learning experience for the library, as well as the Preservation Office. Lisa Biblo had primary responsibility for the operation of the pilot program in its first year and worked closely with the libraries and Akzo to make the pilot a success. Richard Miller made numerous trips to Harvard to answer questions, discuss treatment concerns, and examine treated materials.

Concurrently with the pilot operational program, Professor Andrew Barron and postdoctoral Associate Andrew MacInness collaborated to conduct additional research on the two deacidification processes Harvard had tested with sample batches. Treated and untreated materials were subjected to SEM (scanning electron microscopy), RBS (Rutherford backscattering), and XPS (x-ray photoelectron spectroscopy). Results were discussed with the vendors and published. The research demonstrated (for the first time) that the DEZ process uniformly deacidifies fibers all the way through the paper. However, the acidic core of *coated paper* (glossy paper with a kaolin or other coating) was not permeated by DEZ . Further research is planned in 1993 to investigate the deacidification of coated paper.

A recent survey of the Loeb Design Library determined that 32% of the monographs and 68% of the periodicals were printed on either all coated or a combination of coated and uncoated paper. The resolution of the coated paper issue is critical information for both mass deacidification and preservation planning.

In addition to assisting Professor Barron with his research, the Preservation Office contributed to a comparative study underway at the Canadian Conservation Institute. Results from this study are expected in 1993.

Seven Harvard libraries/collections participated in the first year of the pilot program. During the first year, approximately $65,000 was spent to deacidify materials from the Law School Library, the reference and map collections of Widener Library (humanities and social sciences), Tozzer Library (anthropology), Loeb Music Library, Kummel Library of Geological Sciences, and the Botany Libraries.

In the second year of the pilot program, additional libraries/collections are participating and Widener Library's Preservation Services Department is sending regular shipments of books through the deacidification process that are slated for repair or rebinding. Julian Stam, Binding Librarian in Widener Library, has assumed responsibility for coordinating the operational aspects of the mass deacidification program, working closely with the HUL Preservation Office.

1.4 Mass deacidification nationally and internationally

There are several research libraries, other than Harvard, that are either using or continue to test the DEZ process. The progress of the Library of Congress, the developer of the DEZ process, was stalled earlier in 1992. However, LC will proceed with their action plan, sending 12 test shipments to Akzo in 1993. One of the objectives of continued testing is to isolate the source of the odor and correct the problem. The Swiss Federal Archives/Swiss National Library has joined the Library of Congress testing program. With the support of the NEH the Harry Ransom Humanities Research Center conducted in a pilot program treating archives and manuscript collections. An initiative by the Association of Research Libraries has resulted in a project to encourage members to move ahead with their plans to begin deacidification programs. The Dutch General State Archives also sent a test shipment of archival materials to Akzo. After inspecting the returned shipment, the Archives indicated that they were comfortable with their intention to send materials in the future. Beginning in February 1993 the Archives will send regular shipments from Holland to Akzo plant in Texas.

In April 1992 the Committee on Institutional Cooperation (CIC) completed its report on mass deacidification. The report investigated the organizational and logistical issues of deacidification, the effectiveness of both commercially available processes, DEZ and FMC, as well as produced data on budget planning and fund-raising. The CIC Task Force on Mass Deacidification established the need for mass deacidification among the CIC libraries and concluded that a consortial approach to deacidification would benefit the CIC libraries.

Although the consortial approach may provide optimum benefits for CIC libraries, Northwestern University used the momentum of the CIC Task Force and contracted for Akzo's services beginning with the treatment of Music and Africana. Likewise, the University of Chicago is also poised to start-up a mass deacidification program and Ohio State University has sent selected collections to Akzo for treatment. Johns Hopkins, the first academic library to contract with Akzo, continues to send monthly shipments primarily consisting of new acquisitions.

2.0 SELECTION

The topic of selection for mass deacidification is being considered on two levels: exploration of an overall intellectual approach and the development of a model(s) based on the pilot operational program to select, send, and receive back materials that have been deacidified.

2.1 Intellectual

During the start-up meeting for mass deacidification in the Harvard libraries, participants were asked to consider mass deacidification as a means of preserving texts in original format. Librarians were asked in particular to consider:

- materials for which they have special responsibility,
- materials that rely on original formats for effective use,
- materials with graphic or visual images as intellectual content,
- research collections that are needed on-site.

Additional determining factors have included: use, relative importance to the whole collection, and in some cases rarity or scarcity. Just as selection for microfilming is the responsibility of the subject specialist, so too is the intellectual or curatorial selection of materials for mass deacidification. The collection manager has the knowledge of the collection and ability to judge the use of segments of the collection. Using the premise that materials selected for deacidification will survive in their original format, librarians have added use, importance to the collection, and scarcity to aid in selection decisions.

2.2 Physical

Once the intellectual decision to deacidify materials has been made, physical selection begins. Granted, librarians choosing materials have been aware of the caveats of treatment and have integrated them into their earliest selection decisions, however after initial selection a more rigorous inspection generally follows. Inspection prior to shipment is conducted according to:

- guidelines based on the treatment experiences of a number of other libraries,
- knowledge generated from tests shipments,
- technical development of the DEZ process by Akzo.

Each item is inspected to evaluate whether it meets the criteria developed in the guidelines. Physical selection is an important and rigorous task. It is necessary to apply the knowledge that we gain from effects on previous shipments to future shipments to avoid unnecessary damage. Different types of damage are directly related to the composition of the materials being treated. While damage is not random, we are not yet to the point where sole reliance on visual sorting is enough to prevent certain types of damage. For example, because of the enormous variety in binding materials, the DEZ process may never be able to treat 100% without any damage. However, this is a limitation or tradeoff that will be acceptable in most cases because the text block has been deacidified and damaged bindings can be replaced.

The initial guidelines developed during the first year of the pilot program acknowledge basic limitations of the process as it has been developed up to this point, and our knowledge of the effects of treatment. The guidelines are a working document designed to reflect what we judge can and cannot be treated successfully; they will evolve as the treatment process becomes more refined.

2.2.1 Leather

The guidelines suggest that artifactual bindings[1], volumes with "red rot," and extremely brittle materials[2] should not be deacidified at this time. Hopefully, research by the Canadian Conservation Institute will provide some insight to how leather is affected by the DEZ process. Despite the lack of knowledge of the effect of DEZ treatment on leather bindings, Harvard librarians have sent leather bound books (mostly 1/2 and 1/4 bound) where the text is of primary importance with the understanding that the book may require rebinding.

[1]The guidelines also suggest that leather bindings should not be deacidified now because the long term effect of alkalizing leather must be researched further.

[2]unless prior to encapsulation

Volumes with "red rot," leather in a state of extreme deterioration, have been treated with Krylon and thus successfully deacidified without dispersal of deteriorated leather particles throughout the vacuum chamber.

2.2.2 Coated Paper

Earlier research into mass deacidification processes performed by Professor Andrew Barron and postdoctoral associate Andrew MacInness of the Harvard Chemistry Department revealed the inability of both the Akzo and Lithco processes to effectively treat coated papers. The investigation suggested that due to the high water content in clay coatings, the DEZ molecule is unable to get past the coating and alkalize the core of the paper. Based on these findings, Harvard has chosen not to send coated papers for deacidification at this time. Books that have scattered coated pages or coated sections that comprise less than 1/4 of the text block have been sent for deacidification, again, understanding the limitations of treatment. *In order to find out how and if coated papers can be successfully treated, Barron and MacInness will undertake further research into coated papers in 1993.*

2.2.3 Adhesives, Labels, and Plastics

Problems with adhesives and labels were well known when the pilot operational program began, however, since there are so many different types of labels affixed to library materials it did not seem sensible to limit treatment because of labels. One strategy is to choose labels, that will be applied in the future, with adhesives based partially on their compatibility with DEZ. The unstable plastics used in spiral bindings and as pamphlet covers are also a problem. These plastics are susceptible to the heat used during the drying portion of the treatment cycle. Some plastic covers also react with DEZ and may become opaque or semi-opaque while spiral bindings become misshapen and unusable. Laminated covers applied with pressure sensitive adhesives can bubble and form channels. *These problems do not prevent these types of materials from being deacidified, but extra steps may have to be taken to return them to usable condition upon their return; spiral bindings and laminated covers may have to be rebound, pamphlets may need new covers, and labels that fall off may need to be replaced. The tradeoff and issues of physical treatment are usually weighed during physical selection.*

2.2.4 Photographs

When photographs deteriorate, they generally do not suffer from embrittlement, but rather image instability due to fading dyes or migrating silver particles. However, in some cases there will be a desire to treat books that contain original photographs, such as theses or scrapbooks. Although, the DEZ process was not developed for the treatment of photographic materials, it might be able to be used to treat text blocks with original photographs (removing the photographs before treatment and replacing afterwards). *However, before this can occur it is important to learn the effect of storage in a DEZ environment on modern photographic materials.* Harvard contracted the Image Permanence Institute to conduct color and black & white photographic activity test to begin to study the issue. The results indicated that black & white photographic materials may be unaffected, while color materials will require further investigation.

3.0 PROCESSING

3.1 Packing

When the selection process is complete, books are ready to be packed for shipment. Books are packed spine down in 12" x 13" in plastic crates lined with foam. Protective boxes or slipcases are removed prior to packing. If volumes or loose paper need additional support or protection they are shipped either with envelopes or regular office folders and occasionally tied with string. Upon arrival at the deacidification plant, the books were transferred to treatment containers.

Near the end of the first year of the pilot program, Harvard began to substitute the original crates with nylon-coated wire containers. Books are packed spine down and interleaved with coated wire spacers. The new containers are the same size as the crates. Books packed and shipped in the new crates are ready for treatment upon arrival at Akzo. Akzo will not have to unpack and repack books that have already been packed by Harvard. Therefore only minimal pre-treatment handling is required. Some concern has been noted about books shifting and damage to covers during shipment, since they fit more loosely in the new container, but this can be overcome by adding extra spacers to take up space at one end. *It remains to be seen whether packing looser or tighter is best and whether foam inserted at the ends would prevent abrasion. Another alternative is to redesign the spacers so that they are flatter, without protruding bumps.*

In addition, in order to fill the whole treatment chamber at one time with a Harvard shipment, the the number of crates to be filled has increased from 36 to 45. In the future crates for oversized volumes and manuscript materials will be available.

Map shipments, although highly successful in treatment, require more labor to pack. Maps are heavy when grouped and can be very large. Currently, maps are sandwiched in between two sheets of binders board that is taped shut around the edges. Approximately one quarter inch of maps make a sandwich; the sandwiches are put in a box that is stuffed with foam, then put into an overpack. Some shifting and movement during shipping was experienced. *A simpler, better method of packing maps needs to be found.*

The system needs to accommodate large and small maps and avoid damage that may be caused by shifting during shipment.

3.2 Shipping

There are two aspects to shipping materials from a Harvard library to Akzo's deacidification plant in Texas: movement around the University and shipment outside the University. During the first year of the pilot, internal movement relied on the HUL messenger and his schedule. The messenger was responsible for moving books and maps from a library to the loading dock at the Cabot Science Center. From the Cabot loading dock, Yellow Freight was responsible for shipment to and from Texas. Shipment was guaranteed in five working days.

The pilot project relied principally on the Cabot loading dock. One of the problems with Cabot is that there are blackout dates at the beginning and end of the school year due to student traffic.

According to Yellow Freight, the Widener loading dock is impractical because the trucks have difficulty entering Harvard Yard; further Widener does not have a pallet jack, a piece of equipment needed to move a loaded overpack. The Law School loading dock is capable of accommodating the truck that picks up the overpack, but the problem is storage space until that time. The area around the Law School loading dock is very small. *As the program progresses, alternative loading docks should be further investigated.*

The movement of materials around the University has been somewhat slow and always subject to the messenger's schedule. In 1993, the Preservation Office purchased a van to make pickups at and deliveries to the libraries for the mass deacidification program, the NEH project, and Harvard's new Conservation Laboratory.[3] The Preservation Office van and driver should result in a smoother, more efficient, and timelier transport operation.

3.3 Record-keeping

The many details of a record-keeping system have been considered by the participants in the pilot operational program. What is the value of a packing list? Who benefits from creating and using a list? Would a list protect vendor and library in case of loss or theft? Will Akzo check books in if they do not need to be repacked in treatment crates?

If a barcode scanning system is employed, then the barcodes are on the front board or inside the book. If not, books packed spine down are impossible to

[3]The Harvard Conservation Laboratory is in rented space at the Massachusetts Archives at Columbia Point in Boston.

read without removing from the crates. Which is the greater benefit? Should mass deacidification emulate the library binding procedures? If combined shipments from more than one library are sent in one overpack then there must be some sensible way for materials to be tracked. *These and other record-keeping issues will be explored further in the second year of the the pilot program.*

3.4 Marking

Another record-keeping issue is how materials should be physically marked to indicate that they have been deacidified. During the pilot, the verso of the title page was penciled deacidified 92 or deacidified DEZ 92. There is also interest in stamping materials. What are the benefits of each?

PRO	CON
MARKING ON THE VERSO OF THE TITLE PAGE	
greater reversibility	could be unintentionally or intentionally removed
could become part of discharging	takes longer
STAMPING ON SPINE	
easily recognizable	could be rebound and forgotten
less labor intensive	
could be done as routine part of recasing	
faster and easier	
STAMPING WITHIN VOLUME	
permanently marks volume	another mark on the volume

This issue will be discussed further in the context of the pilot program, but it is essentially an issue for individual libraries to address.

3.5 Bibliographic Record

After physically marking the item, the bibliographic record of the deacidified item needs to be marked in such a way that, if for any reason, a report of deacidified items was desired this would be possible. As mass deacidification activity increases the need to search deacidified materials may arise. It could be helpful to see which related areas of a subject class had been deacidified as input to the selection process.

Some libraries have reported deacidification information in subfield k of the location field. This will allow them to pull together lists of deacidified materials. Eventually the use of ≠k will be discouraged in favor of a standard reporting method for preservation information within the Item Record. To this end a request to the Office of Information Systems (OIS) has been made to establish a code in the Item Record for reporting preservation actions.

Is notification to national databases necessary or desirable? As yet, national reporting has not been done by anyone. The Preservation Office is investigating this issue.

3.6 Turn-around-time

The turn-around-time for a mass deacidification shipment is affected by a number of factors: the movement of books and maps around the University, shipping time, and treatment time. To these factors others are brought to bear such as, schedules, equipment and even weather. External shipping has become more consistent with the progression of the pilot; what needs improvement is the ability to move things around within the University and Akzo's improvement of processing time. The Preservation Office van should alleviate many of the problems with transporting shipments to and from the loading dock, and Akzo's new post-treatment chamber will allow them to treat materials in a time efficient manner. Originally, the expected turn-around-time was 21-28 days from departure to return, with these improvements it is very likely that this goal can be attained.

4.0 TREATMENT CONCERNS

4.1 Types of Damage Observed

The majority of books and maps sent from the Harvard libraries to Akzo for deacidification returned in good condition without serious damage. The library materials which have undergone treatment have acid neutralized and buffered papers that will enable the book or map to resist deterioration.

There are two major categories of text block damage: superficial, and that which renders an item completely unusable. There was a single occurrence during the pilot where a book became unusable due to blocking. The cause of the blocking is still undetermined and it is not yet known whether conservation work can open the pages enough to bring the book back to usable condition.

The broad category of superficial damage can be further divided into minor and major. Minor damage includes: aesthetic problems, such as iridescent rings, white rings of excess zinc oxide, brown deposits of zinc oxide around the edges of text blocks, and temporary blocking of photocopied pages. These problems do not inhibit the use of a volume, yet they are unappealing and will be unacceptable if they occur frequently. Cockling is a minor problem that subsides as books gradually reabsorb the moisture from the atmosphere.

Incomplete treatment of materials is obviously viewed as a major problem. Although books and maps can be successfully retreated, it presents a significant confidence problem as well as raising the question whether quality control procedures should be enhanced.

Since most of the library materials that have been deacidified thus far have been selected to preserve the text block, most binding damage can be considered less important. For example, a damaged case can be replaced as long as the pages are still flexible and intact.

Treated bindings also exhibit various types of damage which can also be divided into the categories of minor and major. "Tiffany" rings and white powdery deposits of zinc oxide are apparent on some covers; both constitute minor damage because use is not impaired. Another minor condition is stiffness in the hinge/joint area which makes books difficult to open. This type of damage tends to diminish as bindings regain moisture. As with text blocks, the ability to continue to use books and maps is a significant criteria by which major and minor damage can be determined.

Binding damage can also be judged by the necessity to rebind. The pyroxylin[4] coating on a library bound book can be attacked causing some covers to flake slightly while others experience extreme flaking. A extreme case of pyroxylin attack is reason to rebind.

The decorative colors and "gold" stamped titles on publishers bindings are also a concern. Examples of 19th century publishers binding and titles of non-western alphabets that lose coloration could become a potential problem. *The loss of impermanent colors on publishers bindings is a condition that should be further investigated.*

The reaction of color illustrations to the process of deacidification is more complex than originally thought. There was evidence of color flaking from bindings, color shifting slightly in maps and archival materials, and the discoloration of a foldout. These effects are limited and are not an alarm signal. The discolored foldout was an isolated observation, it darkened in areas that corresponded to the manner in which the page was folded and there is no explanation for the occurrence. The archival materials did not use color to provide information and maps shifted slightly but uniformly. In addition the color loss on bindings has been unsystematic and, impossible to predict.

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[4] Pyroxylin treated fabrics are either coated or impregnated with gelatinized nitrocellulose for increased strength and resistance to water, insects, and fungi. During the manufacturing process of buckram, pyroxylin cloth, a primer is used to adhere the cloth and nitro-cellulose. It is the primer coat that is attacked during treatment causing the nitrocellulose to flake.

In many case the selection of library materials for mass deacidification is based, in part, on whether the item is illustrated or not. Many maps and illustrated texts use color as an encoding mechanism or to represent an object or subject in order to enhance the informational value. Representational images rely on color to provide an accurate rendition of an item and any color shift would further remove the illustration as the representation of the original. Shifting color in encoded materials may present problems if the shift is not uniform. Certain materials do exhibit slight shifts in the color after deacidification and the color shift has been uniform. Although there is no data from Akzo that suggest color should be a concern, it is known that dyes and pigments that rely on pH to stabilize color can shift. Colors that are pH stabilized tend to be in the blue/green family and shift uniformly. *There is obviously more to know about color, its method of application, and they way color reacts to changes in its environment and DEZ treatment.*

The DEZ process uses gas diffusion to alkalize paper, and theoretically in a non-aqueous process water-based colors should not run. However, another problem with color came up when Akzo altered the post treatment conditioning phase of the process. Initially post-treatment was completed inside the vacuum chamber, but now books are conditioned in a separate chamber[5] and do not remain in the vacuum chamber long enough to absorb all of the water vapor flushed through during the final phase of treatment. When the seal on the vacuum chamber is broken water that has condensed on the chamber walls may splatter materials on bottom shelves causing water damage. This is particularly disturbing when the materials affected contain water-soluble color inks. Akzo is aware of this situation and will add water vapor at a slower rate and under lower pressure to avoid condensation on the chamber walls, hopefully alleviating the problem.

4.2 Occurrences of Damage

It is estimated the approximately 20% of each shipment was affected by some type of minor damage, this figure was significantly lower for map shipments. The amount of damage other than aesthetic was very small and did not affect every shipment. Of the 3700 books treated during the first phase of the pilot program only 1 was rendered unusable. Conditions that require rebinding or conservation treatment typically occur in several volumes in each shipment of 200-300 books. Overall, treatment is consistent and even throughout text blocks and in many cases a dissipating odor is the only evidence that treatment has occurred.

The presence of an odor in materials that have been deacidified is however a bothersome and in some cases offensive side effect of the process. It has been

[5]For further discussion of the new post treatment chamber see section 6.3 Process developments at Akzo.

established that the odor is not harmful or threatening to humans and dissipates over time. *In 1993, Akzo will work with the Library of Congress to isolate and solve the odor problem.*

4.3 Quality Control

The review of materials upon return from treatment is a subjective exercise. Visual inspection, with the help of a black light, has yielded damaged items which are in turn discussed by librarian, library staff, the Preservation Office staff, and a representative from Akzo. Together the problems were discussed in an effort to refine physical selection guidelines, as well as the treatment process, to produce a better end product.

One of the most frequent remarks during post-treatment inspection is "I don't remember if this was like this before or not." Unfortunately there is no easy way to compare pre- and post-treatment items and extensive testing is not practical in an operational program. Individual shipments are too small to develop a statistically accurate random sample. Is the time involved in an extensive analysis of a 300 book shipment, both before and after treatment, worth it? In a recent shipment from the Widener library near duplicate text blocks were discovered and retained as controls, in order to compare with books after treatment. *In the second year of the pilot program additional strategies for quality control will be explored*

5.0 NUMBERS AND COSTS

During the first year of the mass deacidification program more than 3700 books were deacidified, the number of books per shipment averaged 310 and the average price per book (including shipping) was $ 12.40. In addition, 4688 maps from the Harvard Map Collection and Kummel Library were deacidified at an average cost of $ 4.35 per map.

Acid degradation threatens the bulk of the collections published over the last 150 years. Each year, thousands of items become unusable. Materials that are too brittle to remain in use can be preserved on microfilm at a cost of $90 dollars per volume.[6] However, for most items, microfilm is not the preservation method of choice, but an option that libraries reluctantly resort to and scholars and faculty reluctantly accept. Although microfilm is adequate for some uses and a deteriorated book can be replaced with a photocopy facsimile for approximately $65 per volume, the Harvard collections contain many materials with graphics, illustrations, and color plates that must be retained in their original form.

[6]Neither costs figures for deacidification or microfilming include full staff costs and indirect costs associated with these activities.

Projected at $6-$10 per book in a large-scale program, mass deacidification is a cost-effective preventive preservation option for the Harvard University Library. Currently the University spends approximately $10.5 million each year to acquire new library materials and adds approx. 330,000 new volumes to the shelves. Library managers estimate that it costs $100 per item to provide intellectual and physical access to new volumes. Thus the cost of initial access to library materials could be roughly expressed as $130 per item. Harvard libraries may want to opt for continued physical access in the future by deacidifying those materials that will become part of the permanent research collections.

6.0 1992/93 PLAN OF WORK

6.1 Participants

Seven Harvard libraries/collections participated in the first year of the pilot program:

- The Botany Libraries
- The Harvard Map Collection
- Kummel Library of the Geological Sciences
- The Law School Library
- Loeb Music Library
- Tozzer Library (anthropology)
- Widener Library - Preservation Services and Research Services

Several additional libraries will send shipments to Akzo in 1992/93:

- Harvard-Yenching Library (East Asian)
- The University Archives
- Loeb Design Library

and possibly several other faculty libraries.

6.2 Further Concerns and Investigations

Foremost on the lists of research initiatives is a project that will investigate the deacidification chemistry of coated paper. The project will be conducted by Professor Andrew Barron, Department of Chemistry, Harvard University. If mass deacidification technology can be altered to deacidify the core of coated paper, then it would provide an option for the preservation of an additional and significant portion of library materials. If coated papers cannot be effectively treated by a mass process this information must be incorporated into selection procedures for mass deacidification and into long-term planning for alternative technologies for physical treatment or reformatting.

Additional issues and concerns brought out during the pilot operational program should also be investigated:

- Helping to define the treatment parameters for oversized books to avoid incomplete treatment and other types of problems.
- Investigating the stability of color used in text blocks and on book covers. This could include: hand coloring, watercolors, printed color, the pH sensitivity of colors, as well as discoloration, shifting, or fading.
- Further investigation of adhesives and the effects during and after the treatment process.
- A better picture of the effects of mass deacidification on leather will be gained when the Canadian Conservation Institute study is completed.
- More research into the storage of color photographs in contact with DEZ treated paper is required.

6.3 Process Developments at Akzo

The vacuum chamber used for treatment is 170 cubic feet and capable of treating approximately 40,000 books per year. The deacidification cycle lasts 60 hours, or 2.5 days, and post treatment conditioning is 4-5 days long. Initially, the treatment cycle and conditioning occurred in the vacuum chamber. The post-treatment conditioning is now done in a modified trailer in a climate controlled area. The conditioning area is filled with air which is equivalent in temperature and relative humidity, 100-140° F, 20% RH, to the air that originally conditioned materials in the vacuum chamber. A separate post-treatment area was designed to allow full utilization of the vacuum chamber and to expedite treatment.

Akzo has also scaled up the number of operators for the pilot plant. Now they can run the treatment chamber 24 hours a day.